

PATENT COOPERATION TREATY

PCT

From the INTERNATIONAL BUREAU

To:

FREEHILLS CARTER SMITH & BEADLE
 101 Collins Street
 Melbourne, VIC 3000
 AUSTRALIE

Date of mailing (day/month/year)
 29 May 2000 (29.05.00)

Applicant's or agent's file reference
 #28512rnm:ss

International application No.
 PCT/AU99/00830

IMPORTANT NOTIFICATION

International filing date (day/month/year)
 28 September 1999 (28.09.99)

1. The following indications appeared on record concerning:

the applicant the inventor the agent the common representative

Name and Address

CARTER SMITH & BEADLE
 Quantas House
 2 Railway Parade
 Camberwell, VIC 3124
 Australia

State of Nationality

State of Residence

Telephone No.

03 9882 0599

Facsimile No.

03 9882 9854

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

the person the name the address the nationality the residence

Name and Address

FREEHILLS CARTER SMITH & BEADLE
 101 Collins Street
 Melbourne, VIC 3000
 Australia

State of Nationality

State of Residence

Telephone No.

61-3-9288 1577

Facsimile No.

61-3-9288 1567

Teleprinter No.

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

<input checked="" type="checkbox"/> the receiving Office	<input type="checkbox"/> the designated Offices concerned
<input type="checkbox"/> the International Searching Authority	<input checked="" type="checkbox"/> the elected Offices concerned
<input checked="" type="checkbox"/> the International Preliminary Examining Authority	<input type="checkbox"/> other:

The International Bureau of WIPO
 34, chemin des Colombettes
 1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Dominique DELMAS

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION
(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
 United States Patent and Trademark
 Office
 Box PCT
 Washington, D.C.20231
 ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 04 May 2000 (04.05.00)	Applicant's or agent's file reference #28512rnm:ss
International application No. PCT/AU99/00830	Priority date (day/month/year) 29 September 1998 (29.09.98)
International filing date (day/month/year) 28 September 1999 (28.09.99)	
Applicant ZIENTEK, Paul et al	

1. The designated Office is hereby notified of its election made:

in the demand filed with the International Preliminary Examining Authority on:

10 April 2000 (10.04.00)

in a notice effecting later election filed with the International Bureau on:

2. The election was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Olivia RANAIVOJAONA
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY
PCT
INTERNATIONAL PRELIMINARY EXAMINATION REPORT

DPCD 19 SEP 2000

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference #28512RNM	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International application No. PCT/AU99/00830	International filing date (day/month/year) 28 September 1999	Priority Date (day/month/year) 29 September 1998
International Patent Classification (IPC) or national classification and IPC Int. Cl. 7 B82B 1/00, 3/00, B44F 1/12, B32B 5/16, 31/12, B42D 15/10		
Applicant SECURENCY PTY LTD et al		

<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 4 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 4 sheet(s).</p>																	
<p>3. This report contains indications relating to the following items:</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; text-align: right; padding-right: 5px;">I</td> <td style="width: 90%; padding-left: 5px;"><input checked="" type="checkbox"/> Basis of the report</td> </tr> <tr> <td style="text-align: right; padding-right: 5px;">II</td> <td style="padding-left: 5px;"><input type="checkbox"/> Priority</td> </tr> <tr> <td style="text-align: right; padding-right: 5px;">III</td> <td style="padding-left: 5px;"><input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</td> </tr> <tr> <td style="text-align: right; padding-right: 5px;">IV</td> <td style="padding-left: 5px;"><input checked="" type="checkbox"/> Lack of unity of invention</td> </tr> <tr> <td style="text-align: right; padding-right: 5px;">V</td> <td style="padding-left: 5px;"><input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</td> </tr> <tr> <td style="text-align: right; padding-right: 5px;">VI</td> <td style="padding-left: 5px;"><input type="checkbox"/> Certain documents cited</td> </tr> <tr> <td style="text-align: right; padding-right: 5px;">VII</td> <td style="padding-left: 5px;"><input type="checkbox"/> Certain defects in the international application</td> </tr> <tr> <td style="text-align: right; padding-right: 5px;">VIII</td> <td style="padding-left: 5px;"><input type="checkbox"/> Certain observations on the international application</td> </tr> </table>		I	<input checked="" type="checkbox"/> Basis of the report	II	<input type="checkbox"/> Priority	III	<input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability	IV	<input checked="" type="checkbox"/> Lack of unity of invention	V	<input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement	VI	<input type="checkbox"/> Certain documents cited	VII	<input type="checkbox"/> Certain defects in the international application	VIII	<input type="checkbox"/> Certain observations on the international application
I	<input checked="" type="checkbox"/> Basis of the report																
II	<input type="checkbox"/> Priority																
III	<input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability																
IV	<input checked="" type="checkbox"/> Lack of unity of invention																
V	<input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement																
VI	<input type="checkbox"/> Certain documents cited																
VII	<input type="checkbox"/> Certain defects in the international application																
VIII	<input type="checkbox"/> Certain observations on the international application																

Date of submission of the demand 10 April 2000	Date of completion of the report 13 September 2000
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer DAVID LEE  Telephone No. (02) 6283 2107

L Basis of the report

1. With regard to the **elements** of the international application:*

the international application as originally filed.

the description, pages 2,3,4,7-13, as originally filed,
pages , filed with the demand,
pages 1,5,6, received on with the letter of 25 August 2000

the claims, pages 15-17, as originally filed,
pages , as amended (together with any statement) under Article 19,
pages , filed with the demand,
pages 14, received on with the letter of 25 August 2000

the drawings, pages 1-9, as originally filed,
pages , filed with the demand,
pages , received on with the letter of

the sequence listing part of the description:
pages , as originally filed
pages , filed with the demand
pages , received on with the letter of

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language which is:

the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
 the language of publication of the international application (under Rule 48.3(b)).
 the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, was on the basis of the sequence listing:

contained in the international application in written form.
 filed together with the international application in computer readable form.
 furnished subsequently to this Authority in written form.
 furnished subsequently to this Authority in computer readable form.
 The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
 The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

4. The amendments have resulted in the cancellation of:

the description, pages
 the claims, Nos.
 the drawings, sheets/fig.

5. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

- restricted the claims.
- paid additional fees.
- paid additional fees under protest.
- neither restricted nor paid additional fees.

2. This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- complied with.
- not complied with for the following reasons:

Claim 1 refers to a security document incorporating an "authentication" device using particles.

Claim 17 refers to a security document incorporating melting and then subjecting to a field to orient particles.

Claim 19 refers to a security document incorporating placing particles in pores.

Claim 23 refers to a security document incorporating using a die to cause a transfer film to deposit the particles.

The particles in each claim are nanoparticles. Nanoparticles are known in security documents, see the two new citations overleaf. Consequently, there is no common novel feature between the claims, and hence there is lack of unity of invention.

However, the subject matter of all claims is similar and the search and examination can be carried out without significant extra effort. There is thus no need for additional examination fees.

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- all parts.
- the parts relating to claims Nos.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims 1-25	YES
	Claims	NO
Inventive step (IS)	Claims 1-25	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-25	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

US 5766764, US 5733480, WO 99/07502, EP 827137

New Citations: EP 465124, WO 94/09180

Novelty & Inventive step - Claims 1- 25

The first four citations only disclose magnetic/conductive recording structures incorporating nanoparticles.

The new citations disclose security arrangements using nanoparticles in a document. However, they do not disclose solid inorganic nanoparticles as defined by claim 1.

Claims 4, 17, 19 and 23 all disclose specific processes that are not disclosed in the citations for the claimed security features.

Hence, claims 1-25 are novel and have an inventive step.

25 August 2000

The International Preliminary Examining Authority
Australian Patent Office
PO Box 200
WODEN ACT 2606

Sir,

RE: International PCT Application No. PCT/AU99/00830
in the name of SECURENCY PTY LTD
Our Ref: 40391637 RNM:DL

We refer to the first Written Opinion dated 26 April 2000 drawn by the International Preliminary Examining Authority in relation to the above-referenced patent application. We request that the specification of the application be amended in accordance with the enclosed Statement of Proposed Amendments.

The following comments are made with respect to the Authorised Officer's objections.

The applicant respectfully submits that claims 1 - 3 as amended are both novel and inventive with respect to the documents cited in the Written Opinion. In particular, International Patent Application No. WO 94/09180 discloses a composite mirror produced using surface chemistry and making use of the properties of metal clusters.

European Patent Application No. 0465124 describes the use of micelles, being organic ABA hydrophilic/hydrophobic block copolymers. The principle objective of this structure is to encapsulate a diamolecule to improve the light fastness and stability of the molecule.

In contrast, the present invention relates to a security document that includes solid inorganic nanoparticles where the shape of the nanoparticle is control in conjunction with the particular inorganic material selected (for example, gold or silver). The purpose of the selection of the material and the controlled shape is to determine the spectral characteristics of the particle as it interacts with light. It is these specific spectral characteristics which lead to the value of such a device in security documents.

101 Collins Street Melbourne Victoria 3000 Australia
Telephone (03) 9288 1577 Int+ (61 3) 9288 1577 Facsimile (03) 9288 1567
DX 240 Melbourne

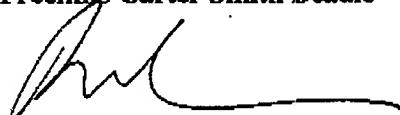
OFFICES IN MELBOURNE AND SYDNEY

The Commissioner of Patents

25 August 2000

Favourable reconsideration of the application is respectfully requested.

Respectfully
Freehills Carter Smith Beadle



Ross N McFarlane

AUSTRALIA
Patents Act 1990

09/787603

IN THE MATTER of International Patent
Application No PCT/AU99/00830
in the name of SECURENCY PTY LTD

STATEMENT OF PROPOSED AMENDMENTS

1. Cancel pages 1, 5 and 6 of the specification at present on file and substitute new pages 1, 5 and 6 submitted herewith in duplicate.
2. Cancel claim page 14 of the specification at present on file and substitute new claim page 14 submitted herewith in triplicate. The third copy being a manuscript copy showing the nature of the proposed amendments.

Dated : 25 August 2000

Freehills Carter Smith Beadle
Patent Attorneys for the Applicant

TO: *The Commissioner of Patents*
Our Ref: 40391637 RNM:DL

SECURITY DOCUMENT INCLUDING A NANOPARTICLE-BASED
AUTHENTICATION DEVICE

The present invention relates to security documents such as banknotes, 5 credit cards and other documents of value, and is particularly concerned with providing a security document with an authentication device for verifying the authenticity of the security document. The invention is also concerned with a method of producing such security documents.

The counterfeiting of currency, stocks, bonds, credit cards and other 10 valuable documents essential to conduct business and financial activities is a continuing serious problem. The widespread availability of high quality imaging systems and the increasing technological sophistication of counterfeiters increases the difficulty of combatting all forms of counterfeiting.

Currently, considerable resources are devoted to the development of 15 devices for incorporation into a security document which can be detected to validate the document's authenticity. Holograms, opaque print strips and microprinting are examples of such devices, and their effectiveness depends upon the difficulties involved in counterfeiting them.

An aim of the present invention is to provide an authentication device for 20 incorporation in a security document which acts to effectively circumvent counterfeiting of the security document.

With that in mind, one aspect of the present invention provides a security 25 document comprising a sheet-like substrate having one or more layers containing solid inorganic particles of controlled shape for forming an authentication device in a first location on the security document, the particles having at least a first dimension in the range of 1 to 200 nanometers.

The particles may be substantially spherical. In another embodiment, the 30 particles may be elongated. In a third embodiment, the particles may be a series of spherical particles concatenated together, in the form of "beads-over-string". In the case of elongated particles, at least a first group of the particles may be aligned so that their longitudinal axes are substantially parallel. The longitudinal axis of

Figure 10 is a schematic plan view showing a lined particle suitable for use in a security document according to the present invention;

Figure 11 is a schematic plan view of particles encapsulated in a clear transparent material for use in a security document according to the present invention;

Figure 12 is a cross-sectional side view of a fourth embodiment of a security document according to the present invention;

Figure 13 is a cross-sectional side view of a fifth embodiment of a security document according to the present invention;

Figure 14 is a schematic diagram showing a first method of locating particles in a substrate so as to form a security document according to the present invention; and

Figure 15 is a schematic diagram showing a second method for enabling the location of particles in a substrate so as to form a security document according to the present invention.

Referring now to Figure 1, there is shown generally a banknote 1 comprising a sheet-like substrate 2 preferably of plastics material and having first and second opposing surfaces 3 and 4. Various indicia may be formed on at least one of the first and second opposing surfaces 7 and 8, such as drawings, writing and other designs well known to manufacturers and users of banknotes.

The substrate is preferably a composite made from at least biaxially oriented polymeric film 5 which is coated on both sides with an opacifying pigment coating 6 and 7 comprising a major portion of pigment in a minor portion of cross-linked polymeric binder. A transparent protective coating (not shown) is preferably applied to both sides of the banknote 1 in order to protect it from wear. The transparent protective layer may include silica or like particles so as to improve the adherence of the banknote 1 when handled by a user.

The substrate 2 includes copolymer outer coatings 8 and 9 of the biaxially oriented polymeric film 5. An authentication device 10 is formed at a first location on the banknote 1 by the inclusion of nanoparticles of controlled shape in at least a portion of the copolymer outer coating 8. These nanoparticles have at least a first dimension

in the range of 1 to 200 nanometers, and, when included in a security document, provide a number of features suitable for use as an authentication device, as will be explained below.

The opacification layer 6 of the banknote 1 does not extend over the entire 5 surface 3 of the substrate 2, but leaves a portion of the substrate 2 uncovered in the vicinity of the authentication device 10. This embodiment of the authentication device 10 takes advantage of particular optical effects of the nanoparticles included in the copolymer outer layer 8 or otherwise visible by a user. In this 10 example, nanoparticles made from gold, silver or other solid inorganic material which scatters and absorbs incident light waves are used in the authentication device 10. Nanoparticles of this type have been observed to exhibit isotropic absorption of incident light waves, their absorption spectrum being a function of both their aspect ratio, that is to say the ratio of their length to width, and their orientation. The absorption spectra for such nanoparticles in solution each having 15 the same width of 10 nanometers but having different lengths is shown in Figure 4. It has been observed that the short-axis polarized band, indicated by the reference "S" does not change in position, whereas the long-axis polarized band, indicated by the reference "L", shifts to a longer wavelength as the length of the nanoparticles increases. In the simplest case, nanoparticles of a spherical shape 20 may be used in the authentication device 10. Such gold nanospheres have been observed to exhibit a colour shift in reflection as a function of the viewing angle α . Such an authentication device will have a typical "green-golden" colour when viewed under specular reflection and appears red-crimson when viewed in diffuse 25 reflectance. The actual "red-crimson" colour which is viewed in diffuse reflectance will depend upon the actual size of the nanosphere and on the thickness of any coating on it.

Alternatively, nanorods, nanoellipsoids or other elongated nanoparticles may be used in order to alter the colour observed by a user both under specular reflection and by diffuse reflectance of light on the surface of the authentication 30 device 10.

CLAIMS

1. A security document comprising a sheet-like substrate having one or more layers containing solid inorganic particles of controlled shape for forming an authentication device in a first location on a security document, the particles having at least a first dimension in the range of 1 to 200 nanometers.
2. A security document according to claim 1, wherein the particles are substantially spherical.
- 10 3. A security document according to claim 1, wherein the particles are elongated.
4. A security document according to claim 3, wherein at least a first group of the particles are aligned so that their longitudinal axes are substantially parallel.
- 15 5. A security document according to claim 4, wherein the longitudinal axis of the first group of particles extend in a first direction at an angle to the plane of the security document.
- 20 6. A security document according to claim 5, wherein a second group of particles are aligned so that their longitudinal axes extend in a second direction at an angle to the plane of the security document, the first and second directions being noncolinear.
- 25 7. A security document according to any one of claims 4 to 6, wherein the first group of particles are arranged so as to polarise incident light waves.
8. A security document according to claim 7, and further comprising, at a second location, a polarising analyser for interaction with the light polariser at the first location.
- 30 9. A security document according to claim 1, wherein the particles are spherical and form a series of particles concatenated together.

FILE COPY

SECURITY DOCUMENT INCLUDING A NANOPARTICLE-BASED
AUTHENTICATION DEVICE

The present invention relates to security documents such as banknotes, 5 credit cards and other documents of value, and is particularly concerned with providing a security document with an authentication device for verifying the authenticity of the security document. The invention is also concerned with a method of producing such security documents.

The counterfeiting of currency, stocks, bonds, credit cards and other 10 valuable documents essential to conduct business and financial activities is a continuing serious problem. The widespread availability of high quality imaging systems and the increasing technological sophistication of counterfeiters increases the difficulty of combatting all forms of counterfeiting.

Currently, considerable resources are devoted to the development of 15 devices for incorporation into a security document which can be detected to validate the document's authenticity. Holograms, opaque print strips and microprinting are examples of such devices, and their effectiveness depends upon the difficulties involved in counterfeiting them.

An aim of the present invention is to provide an authentication device for 20 incorporation in a security document which acts to effectively circumvent counterfeiting of the security document.

With that in mind, one aspect of the present invention provides a security 25 document comprising a sheet-like substrate having one or more layers containing ~~so lots~~ ^{of} ~~nanogangs~~ ^{controlled shape} particles for forming an authentication device in a first location on the security document, the particles having at least a first dimension in the range of 1 to 200 nanometers.

The particles may be substantially spherical. In another embodiment, the 30 particles may be elongated. In a third embodiment, the particles may be a series of spherical particles concatenated together, in the form of "beads-over-string". In the case of elongated particles, at least a first group of the particles may be aligned so that their longitudinal axes are substantially parallel. The longitudinal axis of

Figure 10 is a schematic plan view showing a lined particle suitable for use in a security document according to the present invention;

Figure 11 is a schematic plan view of particles encapsulated in a clear transparent material for use in a security document according to the present invention;

Figure 12 is a cross-sectional side view of a fourth embodiment of a security document according to the present invention;

Figure 13 is a cross-sectional side view of a fifth embodiment of a security document according to the present invention;

Figure 14 is a schematic diagram showing a first method of locating particles in a substrate so as to form a security document according to the present invention; and

Figure 15 is a schematic diagram showing a second method for enabling the location of particles in a substrate so as to form a security document according to the present invention.

Referring now to Figure 1, there is shown generally a banknote 1 comprising a sheet-like substrate 2 preferably of plastics material and having first and second opposing surfaces 3 and 4. Various indicia may be formed on at least one of the first and second opposing surfaces 7 and 8, such as drawings, writing and other designs well known to manufacturers and users of banknotes.

The substrate is preferably a composite made from at least biaxially oriented polymeric film 5 which is coated on both sides with an opacifying pigment coating 6 and 7 comprising a major portion of pigment in a minor portion of cross-linked polymeric binder. A transparent protective coating (not shown) is preferably applied to both sides of the banknote 1 in order to protect it from wear. The transparent protective layer may include silica or like particles so as to improve the adherence of the banknote 1 when handled by a user.

The substrate 2 includes copolymer outer coatings 8 and 9 of the biaxially oriented polymeric film 5. An authentication device 10 is formed at a first location on the banknote 1 by the inclusion of nanoparticles in at least a portion of the copolymer outer coating 8. These nanoparticles have at least a first dimension

*+

in the range of 1 to 200 nanometers, and, when included in a security document, provide a number of features suitable for use as an authentication device, as will be explained below.

The opacification layer 6 of the banknote 1 does not extend over the entire surface 3 of the substrate 2, but leaves a portion of the substrate 2 uncovered in the vicinity of the authentication device 10. This embodiment of the authentication device 10 takes advantage of particular optical effects of the nanoparticles included in the copolymer outer layer 8 ~~or otherwise visible by a user~~. In this example, nanoparticles made from gold, ^{silver} or other material which scatters and absorbs incident light waves are used in the authentication device 10. Nanoparticles of this type have been observed to exhibit isotropic absorption of incident light waves, their absorption spectrum being a function of both their aspect ratio, that is to say the ratio of their length to width, and their orientation. The absorption spectra for such nanoparticles in solution each having the same width of 10 nanometers but having different lengths is shown in Figure 4. It has been observed that the short-axis polarized band, indicated by the reference "S" does not change in position, whereas the long-axis polarized band, indicated by the reference "L", shifts to a longer wavelength as the length of the nanoparticles increases. In the simplest case, nanoparticles of a spherical shape may be used in the authentication device 10. Such gold nanospheres have been observed to exhibit a colour shift in reflection as a function of the viewing angle α . Such an authentication device will have a typical "green-golden" colour when viewed under specular reflection and appears red-crimson when viewed in diffuse reflectance. The actual "red-crimson" colour which is viewed in diffuse reflectance will depend upon the actual size of the nanosphere and on the thickness of any coating on it.

Alternatively, nanorods, nanoellipsoids or other elongated nanoparticles may be used in order to alter the colour observed by a user both under specular reflection and by diffuse reflectance of light on the surface of the authentication device 10.

CLAIMS

1. A security document comprising a sheet-like substrate having one or more layers containing ^{solid inorganic} particles, for forming an authentication device in a first location on a security document, the particles having at least a first dimension in the range of 1 to 200 nanometers.
2. A security document according to claim 1, wherein the particles are substantially spherical.
3. A security document according to claim 1, wherein the particles are elongated.
4. A security document according to claim 3, wherein at least a first group of the particles are aligned so that their longitudinal axes are substantially parallel.
5. A security document according to claim 4, wherein the longitudinal axis of the first group of particles extend in a first direction at an angle to the plane of the security document.
6. A security document according to claim 5, wherein a second group of particles are aligned so that their longitudinal axes extend in a second direction at an angle to the plane of the security document, the first and second directions being noncolinear.
7. A security document according to any one of claims 4 to 6, wherein the first group of particles are arranged so as to polarise incident light waves.
8. A security document according to claim 7, and further comprising, at a second location, a polarising analyser for interaction with the light polariser at the first location.
9. A security document according to claim 1, wherein the particles are spherical and form a series of particles concatenated together.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00830

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl⁶: B44F 1/12, B32B5/16, 31/12, B42D 15/10, 101:00, 209:00, 211:00, 217:00, 223:00, 225:00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B44F 1/IC, B32B5/IC, B42D15/IC, G01N 29/IC

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT: secur: or bank(w)note# or verif: or partic: and diameter or size or meter or metre or nano: or gran:

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5766764 A (OLLI et al.) 16 June 1998 see, in particular, col. 1, lines 66-67, and col.2, lines 22-26.	1-16
X	US 5733480 A (LEE) 31 March 1998 see, in particular, col. 4, lines 38-47.	1-16

Further documents are listed in the continuation of Box C

See patent family annex

* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" Document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means		
"P" document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search
12 October 1999

Date of mailing of the international search report

18 OCT 1999

Name and mailing address of the ISA/AU
AUSTRALIAN PATENT OFFICE
PO BOX 200
WODEN ACT 2606
AUSTRALIA
Facsimile No.: (02) 6285 3929

Authorized officer

BARRY STEPHENS
Telephone No.: (02) 6283 2106

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU 99/00830

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99/07502 A (KANSAS STATE UNIVERSITY RESEARCH FOUNDATION) 18 February 1999 see, in particular, the Abstract.	1-16
X	EP 0827137 A (DOWA MINING CO. LTD.) 4 March 1998 see, in particular, page 3, line 45.	1-16

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/AU 99/00830

Box I Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box II Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. A security document as defined in claim 1
2. A method of producing a security document as defined in claim 17.
3. A method for producing a security feature as defined in claim 19.
4. A method of producing a security document as defined in claim 23.

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims
2. As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU 99/00830

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member	
EP	827137	JP	10-069629
		US	5 902 676

END OF ANNEX